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Impact of the FDI on Productivity in Romanian Manufacturing Industry

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Abstracts

The measure of productivity is as yet a controversial problem. Our approach on productivity considers the concept of production function, but drops the usual neoclassical hypothesis of optimal output planing of the company.

The models consider the foreign direct investment and also the exports as two 3 levels factors and a factorial analysis is conducted. The study of the data-base of the Romanian manufacturing firms reveals that predominant foreign-owned firms perform better than the predominant Romanian private firms and both of them perform better than the predominant state-owned firms. However, the bipolar structure of the predominant foreign-owned companies class must be mentioned: the best performance firms and the low-performance firms.

1. INTRODUCTION

On the economic level, the fall of the communist system in Romania generated a sudden change in the relationship with the West as all trade restrictions were rapidly raised. Consequently Romania has significantly increased its trade flows with the Western economies. At the same time, despite the low level of the FDI inflows in the Romanian economy, they seem to grow in importance as a source of capital.

International experience and achievements show that, beyond the efficiency improvement in the most exposed industries to world markets, foreign trade and FDI may highly stimulate productivity growth in manufacturing. We think it to be one of the main reasons for the theories in the field to recently point out the role of outward opening of an economy in facilitating information and new technology transfer.

1.1 Present status of economic research in the field

Rich literature based on case studies illustrates the way the manufacturing sector and manufacturing companies are adopting new technology and know-how. This literature emphasizes the important role of imports and opening to international trade in technological learning and getting know-how, both by re-engineering and direct inputs in production and by communication with and information from foreign partners (suppliers or customers). Some recent studies come to the conclusion that trading with R&D intensive countries leads to higher productivity growth in the domestic industries.

However, such results matching the assertions made under the conventional literature about economic growth are unlikely to reveal too much in connection with the way the technological transfer takes place. In this regard, besides case studies, most existing empiric facts are based on aggregate data or cross-sectional surveys, which made the subject matter of numerous interpretations.

For instance the new technology may be embodied in goods and transferred by imports of new differentiated products or capital assets and equipment [Feenstra, Markusen and Zeile, 1992] or by direct trade with intellectual property rights (i.e. licensing contracts). At the same time companies may acquire new technology by exports to their partners who share with them information on products design and production technique. A technology transfer may be also made within formal cooperation arrangements between foreign and local companies i.e. by FDI in the form of acquisition of the controlling equity stock and/or joint ventures. In all such cases, in order to purchase new technology the beneficiary is required to provide properly skilled and experienced labor so that new technology may be implemented. Researches demonstrate that the lack of such capability of the beneficiary can't be ignored. This is most often the reason for the fact that the total factor productivity (**TFP**) achieved by companies in a developing country is less than the TFP achieved by companies of industrialized nations, even if identical production equipment is used [Pack/1987].

On the other hand research studies emphasize the difference between technology transfer under formal collaboration deals of foreign companies with domestic ones and that done under “arms-length” direct contacts. The latter including “arms-length” trade with machinery and components as well as direct know-how purchases (payments for patents, designs, sketches etc) may represent a significant way of technology transfer. Yet, technologies are not all available under “arms-length” system. Technology may mostly be acquired only by formal agreement - either by purchase of the controlling equity stock or by establishing joint ventures. Theoretically, companies are supposed to be reluctant about products and know-how “unpacking” and sale when significant stimulus are given for internalizing them. Therefore FDI could be preferred when taking advantage of knowledge [Markusen/1998].

As a conclusion, one may say that the empiric micro-economic literature highlights three main channels transmitting technology and know-how: (1) imports of new capital and differentiated intermediate goods; (2) learning by exports; (3) foreign investments [Djankov and Hoekman, 1998].

Studies regarding the relationship between performances in economic growth and foreign investment presence in the transition East European countries point up that foreign direct investments (FDI) bring about a distinct improvement of the economies. It was identified a positive influence on exports, investments, productivity and sales of goods and services. These studies consider the critical mass of foreign investments must be 40-60% of GDP to exercise a significant influence on the economic growth.

Estimations regarding Romania's situation show that, at an aggregate level, a significant positive impact of FDI cannot be identified either on productivity performance or on exports or economic growth. Such situation can be explained by a rather small volume of FDI, which represents only about 13% of GDP [Croitoru & others, p.42].

2. METHODOLOGY

2.1 Generalities

A great part of the literature based on econometric studies has been so far focused on measuring the productivity as a substitute for measuring technology diffusion. Previous studies, using aggregate data at industry sector level, have found that the labor productivity in the receiving country is positively influenced by foreign presence in the respective industry sector. However, more recent studies, using data available at companies' level are less conclusive as to the existence of such spillover effects. Thus, Aitken and Harrison [1997] find that FDI has a negatively impact on the domestic owned companies. At the same time, Harrison [1996] suggests that, on the markets with imperfect competition, the foreign investors' penetration brings about the loss of market shares by the domestic competitors. [A quite similar finding is revealed by the UNCTAD "World Investment Report 1999-Foreign Direct Investment and the Challenge of Development", pp. 171-173 and 189-191]. Here, the matter is tackled in relation to the crowding-out effects induced by the investing transnational companies to the domestic competitors, a fact that (in Harrison's opinion) alters the ability of the domestic companies to achieve economies of scale.

Such outcomes of various econometric studies emphasizing the negative spillovers are, on the other hand, opposite to the findings of the literature based on case studies. To a certain extent, this state of facts may reflect that in the most case studies some significant variables are omitted, such as the R&D expenditures, professional training expenses and the magnitude of high-skilled staff employment (engineers, researchers).

In this context, the background analysis of our study consists of: **1) the estimation of the production functions; 2) the interpretation of the total factor productivity (TFP) as an indicator of the technological and know-how level; 3) the analysis of the way FDI and exports act on the production function by modifying the production factors contribution; 4) the static approach of TFP** (it refers to one year data - the year 1998- consequently cannot reveals the productivity dynamics). We accept the conjecture "At a certain moment, TFP level is one of the determinants of the future development of productivity". Thus, when we rely on TFP as a static variable depending on exports and

FDI we assume that the adoption of the new technologies and know-how will bring forth, even with a time gap, a productivity improvement.

We do not disregard that our assumption brings up a thorny question about the dependence of the productivity improvement on the technological capacity of the domestic companies [see a detailed analysis in Djankov and Hoekman/1998]. Obviously, the actual technological capacity and the differences between the companies in a certain industry can be an important determinant of the **TFP**'s level. We must make clear that such data on Romanian manufacturing enterprises were not available for our study. The reason is that data on the variables with technological significance -such as expenditures for R&D or qualification labor structure- are not equally available, to be compared, in the Romanian micro-economic statistics we have had access to.

It is our assumption that a real capacity of productive efficiency growth exists in the Romanian economy as a whole and that undertaking the best techniques and practices by technology transfer (hard and soft) is of great importance. We share the opinion that "technological freezing" still characterizing in a great extent the Romanian industrial sector is not as much the expression (endogenous) of a poor capacity of technological undertaking/assimilation, but the result (exogenous) of the low level of structural adjustments and corporate restructuring processes. The formal character of privatization (especially through the Mass Privatization Program) and preservation of the old technological structures explain the weak exposure of the manufacture sector to the influence of technological processes in the world economy and, in this way, explain the technological stagnation to which we have referred earlier.

2.2 Model definition

In our study the firm's production function will be defined under Cobb-Douglas model as it follows:

$$Y= A\, K^{\alpha}\, L^{\beta}\, M^{\gamma}\, S^{\delta} \qquad \textbf{(1)}$$

Where all the following variables refer to year 1998:

Y – the production, including: sales + finished goods inventories changes (balance receivable stocked production minus balance payable stocked production) + production of fix assets

K – the capital, referring to tangible assets

L – labor, meaning the mean number of employees (productive and non-productive)

M – materials, including the value of the raw materials and consumption materials (including power, water and other material expenses)

S – subcontracted services, meaning the value of the works executed and services rendered by third parties

A – the total factor productivity (**TFP**) measuring 1) the actual technology level; 2) the efficiency of organizational and managerial practices. **TFP** includes all causes leading to the productivity changes, which are independent of K, L, M and S (i.e.: technological level of capital and not only its value; labor skill level; managerial competence; market condition etc). The total factor productivity A is not a directly observable variable.

No hypothesis about the 1-order homogeneity of Y function is advanced (no constant return to scale), so generally:

$$\alpha + \beta + \gamma + \delta \neq 1.$$

Considering the variables in equation (1) as time functions, we may write the productivity equation:

$$dY = (\partial Y/\partial A)\, dA + (\partial Y/\partial K)\, dK + (\partial Y/\partial L)\, dL + (\partial Y/\partial M)\, dM + (\partial Y/\partial S)\, dS \qquad (2)$$

In the special case of the production function Y given by relation (1), the equation (2) becomes:

$$dY = (Y/A)\, dA + \alpha(Y/K)\, dK + \beta(Y/L)\, dL + \gamma(Y/M)\, dM + \delta(Y/S)\, dS \qquad (3)$$

Further on, we will accept the model suggested in 1942 by Tinbergen, subsequently developed by Solow in 1957, where the total factor productivity A is:

$$A(t) = A(0)e^{\lambda t} \qquad (4)$$

If time 0 should be considered a reference – but, on a reason to be mentioned below, we cannot do so – then A(0) = 1 and TFP should become:

$$A(t) = e^{\lambda t}\ . \qquad (5)$$

Considering the relation (4), the Solow residual is λ:

$$\lambda = A'/A. \qquad (6)$$

Under these conditions, the productivity equation (3) becomes:

$$dY/Y = \lambda\, dt + \alpha\, (dK/K) + \beta\, (dL/L) + \gamma\, (dM/M) + \delta\, (dS/S) \qquad (7)$$

On the other hand, having in view relation (4), by taking the logarithm of both sides, the equation (1) becomes:

$$\ln Y = \ln A(0) + \lambda\, t + \alpha \ln K + \beta \ln L + \gamma \ln M + \delta \ln S \qquad (8)$$

Consequently, the study of the productivity means to interpret the parameters λ, α, β, γ, δ in the context of equation (7). However these parameters will be determined using equations of type (8).

Definitely, we shall estimate λ, α, β, γ and δ coefficients for t=1 using the least squares method in the equations:

$$\ln Y_i = \lambda + \alpha \ln K_i + \beta \ln L_i + \gamma \ln M_i + \delta \ln S_i + \varepsilon_i \quad i\in \mathbf{S} \qquad (9)$$

where: i – identifies a firm

$\mathbf{S}$ – is a part of the set of manufacturing firms (λ, α, β, γ and δ are thought constant for all the firms in $\mathbf{S}$)

ε_i – is an random variable with $E[\varepsilon_i] = 0$ and $D[\varepsilon_i] = \sigma_s^2$.

The random variable ε_i has been attached to each firm to describe the error as against the hypothesis of the considered model. This variable also includes the term $\ln A(0)$ of the equation (8), term characterizing each firm. (It is now clear that the value A(0)=1 may not be a reference for all firms. So, in our case, it is not appropriate to replace relation (4) by (5).)

To study the impact of ownership-type and exports on productivity we applied the factorial analysis techniques. The factors on interest were the ownership-type and the level of the exports. For each factor we compared the log-linear regression equations (9) defined for various sub-sets $\mathbf{S}$ of manufacturing firms –one equation for each level of the factor.

More precisely three levels of **TP,** the ownership-type factor, have been considered:

- predominant-STATE owned, referring to the manufacturing firms with prevalent state equity (the biggest equity share belongs to the state);
- predominant-ROMANIAN-PRIVATE owned, referring to firms with prevalent domestic private equity;
- predominant-FOREIGN owned, referring to firms with foreign prevalent property.

Within these three categories the percentage of predominant ownership is at least 33.33%, by definition, but more often in the case of Romanian manufacturing industry, the predominant ownership means the majority ownership (more than 50%).

As to the export level (**EXP** factor) 3 intervals of the weight of export revenues in the total turnover of a company were considered, as follows:

- exports level 1 - enterprises with the weight of export revenues in the total turnover (marked by **Vexp/Turnover**) in the interval [0%-25%);
- exports level 2 - Vexp/Turnover within the interval [25%-75%);
- exports level 3 - Vexp/Turnover within the interval [75%-100%].

2.3 Variables transformation

Our model estimates values of the parameters λ, α, β, γ and δ (using type (9) equations). By the hypotheses of the model, the values of the parameters are common for firms from several NACE classes. (As we mentioned before, the estimated values depend on the level of the factors but not directly on the

NACE class.) Under such circumstances the use of price indexes for Y, K, L, M and S seems to be necessary. Having in view that a manufacturing firm may, generally, develop its activity in more than one NACE class it is difficult to establish accurate price indexes for each company. To use price indexes specific to the main business line of a company is an acceptable (but obviously approximate) solution.

Thus, the price indexes should change according to the NACE class (or subsection) of the firm's main business line. But we will avoid the use of indexes by the transformation of the variables. In fact, each of the five variables Y, K, L, M and S will be divided by the appropriate geometric means of the respective variables. Corresponding to each firm, the geometric mean will be calculated for the NACE class (4-digits code) of the main business line of the firm. The advantages of such approach are:

(i) – The price indexes for the NACE classes (groups, subsections) may be ignored (as the transformed variables are invariant to the scale transformation).

(ii) – None of the equations (1)-(4) and (6)-(9) changes its structure if the conventional measure units for Y, K, L, M and S are replaced for each NACE class (4 digits code) by Y^*, K^*, L^*, M^* and S^*, the geometric mean of the class.

(iii) – The transformed variable values may be explained as deviations from a reference value. Such reference value (the above-defined geometrical mean of the related variable) offers cross-sectional information about the related NACE class.

Important remark: from now on, the transformed variables Y/Y^*, K/K^*, L/L^*, M/M^* and S/S^* will be marked with Y, K, L, M and S (in order to avoid to complicate the notation). But they must be interpreted under the above (iii) observation, as deviations from the reference value of the NACE class the firm belongs to (due to its main business line).

2.4 Explanatory remarks

1. Contrary to the usual method, the parameters from the productivity equation (2) (in our case the parameters α, β, γ and δ) will be estimated by statistical methods. The neoclassic methodology determines the parameters of the productivity equation separately for each firm, as a ratio of expenditures for capital, labor, materials and subcontracting. This approach is the solution of a restricted optimization problem. The main hypothesis advanced by the neoclassic model is the profit maximization under the restrictions imposed by the production function structure (that is an "optimal managerial behavior" in a certain meaning). However, this hypothesis does not match with the condition of a transition economy. In the case of Romania, the quasi-absence of restructuring, an often conventional and too slow process of privatization throughout the first 10 years of transition and a relative unfavorable economic environment do not allow the acceptance of the hypothesis of an "optimal managerial behavior".

2. It has to be underlined that our model will estimate the parameters λ, α, β, γ, δ as outcomes relative to some appropriate sets of firms. (See the set $\mathbf{S}$ in the relation (9).) This set will be defined by taking into account the two factor of interest, the type of the ownership and the level of the exports.

3. Our model will deal with **the static approach to productivity** (the usual approach is the dynamic one, by studying the time-variation of TFP, in connection to the variations of the endogenous and the exogenous variables). Our preference for the static analysis of productivity is legitimate by two types of arguments.

- On the one hand, our reason relates with the individual firm level. Following the privatization process, many Romanian firms have changed their ownership statute. Generally speaking, after 50 years of state ownership such a change brings about deep shocks at company level. All these shocks will be reflected by the production function and, of course, will appear as observable or unobservable modifications in the productivity equation. But, these can be rather considered as consequences of **a major change in the ownership statute** of the firm and the subsequent restructuring, than the consequences of **the ownership-type characteristics** of the firm, *per se*. However, our concern doesn't relate to the impact of major change in the ownership statute, but with the influence of the actual ownership-type characteristics on productivity. In fact, the general concept of productivity evolution is meaningless in the case of firm's high non-stationary time periods. So, we must avoid including in the analysis the companies during their major reorganizing period.
- On the other hand, our approach relates to the Romanian industry level, as a whole. The strong non-homogeneity of the period can not be ignored. Thus, in 1997 significant FDI were made (as well as in 1996) but the 1998 year of a severe recession followed. Additionally, throughout this period the economic laws and regulations were often amended, having a strong impact on the economic environment. Also, some economic agents obtained various facilities and exoneration (obviously, to the prejudice of others). The exception became an almost systematic practice. (To say "exceptions become systematic" seems a contradict in terms. However, it depicts the true condition of the Romanian economic environment between 1997 and 1999). Under such conditions, the productivity fluctuations (made clear by accounting) can be real but they might also exclusively be an outcome of some events having nothing in common with the production process. In order to limit, as much as possible, these distortions caused by temporal non-homogeneity of the economic environment, we have restrained ourselves to make a static analysis for 1998 year (having implicitly in view that in 1998 the economic environment non-homogeneity was obviously less then during 1996-1998 period).

To emphasize the static feature of our analysis, the Solow residual defined by equation (6) (the parameter λ) will be called henceforth **"the static index of total factor productivity"**, abbreviated **SITFP**.

4. Our initial intent to tackle only the capital (K) - labor (L) model was not satisfactory for two reasons:

- The way in which, during the years following December 1989 the Romanian companies' assets were valued determined a poor accounting recording of the capital value (tangible assets). Thus, the book value of the capital cannot bring truthful information about the real value of the tangible assets.
- The extent of the tangible assets utilization is different for each company and has a great variance. (See Figures 6-8 in Appendix A2).

2.5 Sample description

Initially, all the 3238 manufacturing firms with an mean number of employees more or equal to 50 in 1997, in accordance with data made available by the National Commission of Statistics, were taken into account. At the first stage about 200 firms were excluded from our study as the National Commission of Statistics could not offer the necessary information for the analysis of t1 he year 1998. The representativeness of this database (about 3000 firms) was assessed in comparison with some aggregate values of NACE divisions or groups (2 or 3 digit codes), published data [The National Commission of Statistics, 1999]. In conclusion we found that our database covers over 90% of the aggregate manufacturing turnover and the divisions or groups where only about 80% of the turnover could be covered are exceptions.

Subsequently, about 200 other firms were excluded on various reasons. The reasons were: the mean number of employees lowered under 50 in 1998; incomplete or wrong data; outliers; the firms belong to a NACE class (4 digit code) including only one item in the database (in such case to transform variables by dividing to the class mean is not pertinent). Finally, the **Basic Sample of 2803 firms** was accepted for the factorial analysis. To ensure the homogeneity of our study and the possibility of subsequent calculation of other indicators based on the ones already calculated in this study, all aggregates were done for the Basic Sample even if the available data for some indicators would have allowed the use of a larger sample.

Additionally, information from other two sources has been used. Data on the degree of capital utilization in 1998 were collected in the first quarter of 1999 from a **separate survey on 1400 firms**. Data about the imported materials were got in the 3rd quarter of 1999 from a **larger survey including 1789 firms**. The time lag between the period this study refers to (year 1998) and that of the last mentioned survey is not a critical one.

The Basic Sample (2803) was supposed to be exhaustive but it is not, due to non-responses, deficient and missing or atypical data. Consequently the sample is not a random one. It does not raise major problems for the analysis at the firm level: the conclusions are relevant to and typical for the Basic Sample; the Basic Sample includes most of the firms, covering 90% of the manufacturing turnover. As to the aggregate analysis at the subsection level, the outcomes must be differently and carefully interpreted, depending on the number of the firms in each subsection (see Table 1, Appendix A1).

The two additional surveys (1400 and 1789 firms) were designed to be simple random samples stratified under the NACE division. The percentage of non-reply is still high. But no major problem arises if we accept the hypothesis –quite a natural one– of the independence between the studied variables (the degree of capital utilization and imported materials) and the reply/non-reply variable.

3. MODELS AND OUTCOMES DESCRIPTION

3.1 Model M1. The log-linear regression model

Variables: Y (exogenous); K, L, M, S (endogenous).

Reference group: manufacturing firms. The model is compatible to the empiric processed data: the value of the determination coefficient is $R^2 = 0.957$.

See the description of the Model M1 in Appendix.

The estimated equation of the model is

$$Y = \underset{(-3.788)}{-0.018\,K} + \underset{(33.579)}{0.298\,L} + \underset{(74.951)}{0.475\,M} + \underset{(48.11)}{0.300\,S}$$

Comments and conclusions:

(1) The absence of intercept, i.e. $\lambda=0$, is a result of the transformation defined in §2.3. As we mentioned before, λ corresponds to the static index of TFP. The reference value of λ is zero, but generally, for a specified level of a factor, the value of λ is non-null (as it will be seen below in the models M2 and M3).

(2) At first sight, the negative value of the coefficient of the variable K is surprising. Such value is statistically explained by the fact that in spite of the fact that the correlation coefficient between Y and K is 0.70, the partial correlation coefficient between Y and K conditioned by L, M and S is -0.07. The value 0.70 of the correlation coefficient is, economically, ordinary. The negative value of the partial correlation may be interpreted as an outcome of a systematically incomplete utilization of the capital K in the Romanian manufacturing industry. Under such circumstances, the capital K may not offer accurate information about the production level. (More accurate information is embodied in L, M, S which, in turn, are implicitly subject to the capital level – more precisely, not all the capital, but the part of the capital effectively in use.) Of course, the unutilized part of the capital is a source for the production costs increase.

(3) The extent of the capital sub-utilization phenomenon may be understood by examining the Figure 6-8, in Appendix A2, synthesizing the outcomes of the survey conducted on 1400 firms. The capital sub-utilization level is high and varies with the NACE subsection, the export level and the prevalent ownership type. A more detailed discussion on sub-utilization of the tangible assets follows in §4.2.

(4) The variance analysis shows, on the other hand, that although the capital is statistical-significant, it affects the production level to a much less extent than the L, M, S do (see Appendix). Actually, (but we shall not discuss here in details) for some sub-sections the capital vanishes completely from the regression equation. In this case, the capital behaves as an extensively used resource, available in unlimited quantity.

(5) The above mentioned assertion should not be misunderstood in the sense that the production outcome does not depend on the capital value. It should be understood as follows: more or less objective macroeconomic restrains, the decrease of the held market segment and some group interests are leading to a capital sub-utilization. The followings must be taken into account:

(i) to re-dimension the capital cannot be easily achieved (sometimes there is no interest to do it, waiting for more favorable circumstances; other times, on the contrary, the capital value is arbitrarily diminished, without a proper substantiation);

(ii) M, S, and even L are sensitively easier to re-dimension depending on the production level. Accordingly, the following conclusion may be drawn: the accuracy of information on the production level embodied in L, M and S is higher than the one in K. (This does not statistically imply any conclusion about causality. In fact, from an economic point of view, at a certain moment, the capital is the one generating restriction for the production and not the reverse. Such cannot be stated under a dynamic model.)

3.2 Model M2. Factorial analysis of production conditioned by the factor EXP (3 levels)

Variables: Y (exogenous); K, L, M and S (endogenous). Factor: EXP, 3 levels of export (Vexp/Turnover is in [0% 25%), [25% 75%) and [75% 100%], respectively).

Reference group: manufacturing firms. Model M2 is compatible to the empiric processed data: the value of the determination coefficient is: $R^2 = 0.964$.

See description of Model M2 in Appendix.

Conclusions regarding Model M2

1. SITFP (above defined TFP static index) as to export level 3 (Vexp/Turnover is in the interval [75% 100%]) is significantly higher than the one for levels 1 and 2. The SITFP is minimal for level 2 of exports.

2. The capital contribution to production function is significantly higher for level 3 than for levels 1 and 2 (due to a higher capital quality and/or higher level of capital utilization; see Figure 8).
3. The labor contribution to production function is significantly higher for level 3 but no significant differences appear between the levels 1 and 2.
4. As to the contribution of the materials expenditure to production function, all differences between levels of factor EXP are significant: materials expenditure contribution decreases (statistically significant) with the increase of export level.
5. The contribution of subcontracting is significantly higher for export level 3 than to levels 1.

3.3 Model M3. Factorial analysis of production conditioned by the factor TP of prevailing ownership-type

Variables: Y (endogenous); K, L, M and S (exogenous). Factor TP: prevalent ownership-type. The three considered levels are: **STATE**, predominant state ownership (level 1); **PrivRO**, predominant domestic private ownership (level 2); **FOR**, predominant foreign ownership (level 3).

Reference group: manufacturing firms. The Model M3 is compatible to the empiric processed data: the determination coefficient has the value $R^2 = 0.960$.

See the description of the M3 model in Appendix.

Conclusions regarding Model M3

1. The coefficient λ of static index of TFP (SITFP) is significantly higher for factor level 3 than for levels 1 and 2.
2. The contribution of the capital to production function is significantly higher for level 3 than for levels 1 and 2.
3. Labor contribution to the production function is significantly higher for level 2 than for levels 1 and 3.
4. Materials contribution to the production function is decreasing (statistically significant) from level 1 to level 3.
5. Contribution of subcontracting to the production function is significantly higher for level 3 than for levels 1 and 2.

4. THE EMPIRIC ANALYSIS OF THE EXPORT AND FDI IMPACT ON THE ECONOMIC PERFORMANCE IN THE MANUFACTURING

4.1 Methodological note

We shall comment aspects brought to light by the descriptive analysis of the database of firms in the manufacturing industry. Means, frequencies, medians and other less usual indicators are to be evaluated and compared. All conclusions will be pointed to on the figures and tables in Appendix. Contrary to the Chapter 3, under this chapter the discussion about the statistic significance of mentioned outcomes will be limited, especially when the analysis compares the 15 subsections EA, EB, …and EO in the manufacturing industry. None of the conclusions to be drawn here in connection with EF subsection is significant as only 9 out of the 2803 analyzed firms mainly conduct activity in the crude oil processing, coal cocking and nuclear fuels treatment industry.

Two less usual but frequently used in Appendix definitions are given hereafter.

Definition 1. Aggregate distribution of X variable conditioned by f factor (with 3 levels):

$$\mathbf{d(X \mid f) = (100 \cdot X_1/X,\ 100 \cdot X_2/X,\ 100 \cdot X_3/X)}$$

where

X_i = the sum of X variable values for all firms for which the factor has the value f="i", sum calculated in an aggregation set ;

$X = X_1 + X_2 + X_3.$

This indicator shows the percentage of the aggregate value of the X variable assigned to each level of the f factor. (Obviously, the definition may generally be written for factors with as many levels.)

Definition 2. The ratio of the aggregate distributions of the variables X and Y conditioned by f factor (with three levels):

$$\mathbf{W(X{:}Y \mid f) = ((X_1/X)/(Y_1/Y),\ (X_2/X)/(Y_2/Y),\ (X_3/X)/(Y_3/Y)) =}$$
$$\mathbf{= (X_1Y/Y_1X,\ X_2Y/Y_2X,\ X_3Y/Y_3X)}$$

where X_i , Y_i, X, Y are those from Definition 1.

For edit reasons, the tables and figures in the appendix will express the ratio of aggregated distribution in percentages, that is the value 1 is to be written 100%.

<u>Comments about W(X:Y | f)</u>

1) W(X:Y | f) is an aggregate indicator with 3 components. (In our case the aggregation set is the manufacturing industry and the f factor is the ownership type TP, a 3 levels factor). Of course, the indicator can also be defined for more than 3 levels of the factor.

2) The first equality of the above definition is more complicated but it has the advantage to be more intuitive.

3) There is no any connection between the values of W(X:Y│f) and the weight of the 3 levels of the factor in the aggregation set.

4) This indicator compares the effects of the factor on the variables X and Y.

If W(X:Y│f) = (1,1,1) then X and Y variables are proportional.

5) If statistics W(X:Y│f) has a higher than 1 component then it also has an under 1 component.

6) The following series of equivalent relations may be written:

$$(X_i/X):(Y_i/Y)>1 \Leftrightarrow X_i/X>Y_i/Y \Leftrightarrow X_i/Y_i>X/Y .$$

So, a higher than 1 value corresponding to the "i"-level of the factor is showing that the "i" level of the factor influences to a greater extent the X variable values than the Y variable values.

7) Or, if we refer to the last inequality, a higher than 1 value is revealing the ratio between the aggregated values for the "i" level of the factor is higher than the ratio between the unconditionally aggregated values within the entire aggregate set, independently of the factor values. More intuitively, but more vague expressed – the "i" level of the factor is inducing high values of the X/Y ratio. (To say 'For level "i" one obtains values of the ratio X/Y above the mean.' may be a suggestive but not an accurate description, because of the inequality

$$(X_1/Y_1 + X_2/Y_2 + X_3/Y_3)/3 \neq (X_1 + X_2 + X_3)/ (Y_1 + Y_2 + Y_3).$$)

8) The statistics W(X:Y│f) will be used for all manufacturing NACE subsections (see Annex). It must however be stressed the weakness of the comparative interpretation of two subsections. So, the following surprising position could appear: all the three components corresponding to a specified subsection are higher than the respective components corresponding to another subsection -but this has no any econometric significance.

4.2 The manufacturing industry: subsection level empirical analysis

The following analysis is not an exhaustive one. Only few aspects subject to be related with the above factorial analysis will be briefly mentioned.

To be concise, the following abbreviations will be used:

- NACE subsections will be identified as EA, EB,…, EO. The codes' legend can be found in the Appendix, Table 2.

- The prevalent ownership structure will be coded as STATE, PrivRO and FOR (see the Model3 in §3.3).

- Each of the conclusions from below will be classified by subject, as it follows: **EXP** Exports; **INV** Investments; **K** Capital (here too, the capital is understood to be the value of tangible assets); **MI**

Materials' Imports; **PrK** Capital Productivity; **PrL** Labor Productivity; **PROF** Profitability; **VA** Value Added.

EXP1. *At individual level of firm*, the frequency and intensity of the export activities are maximal for FOR (see Table 1). Indeed, the exports exceed 75% from turnover value for 46% from the FOR firms, but only for 4% and 18% from STATE and PrivRO firms, respectively. More, the percentage of the firms without any export activity is 30% for FOR firms, but 50% for domestic firms (PrivRO or STATE).

EXP2. *At aggregate level of manufacturing industry*, the conclusion seems to be different. The exports share in the aggregate turnover is maximal for STATE (29%, comparing to 24% and 25% for PrivRO and FOR; see Table 14).

EXP3. *At aggregate level of subsections,* the subsections in which the FOR works mainly for exporting are EB, ED, EO (the aggregate export aimed production represents over 70% of the aggregate turnover of FOR); EJ, EK, EL and EN (between 54% and 69%). On the other side, in the subsections EA, EE, EH and EM, the FOR sector exclusively works for domestic market.

The Romanian private sector mainly works for export in subsections EB, EC and EO (between 54% and 57% of the aggregate turnover).

EXP4. The analysis a*t individual level of the firm* reveals that 14% of the exporting firms make exports at a loss (that is export expenses are higher than export revenues). The situation is synoptically described in Figure 18 for approximately 1500 firms with exporting activities. The PrivRO sector has the minimum percent of losing-exports firms. In STATE and FOR sectors the losing-exports firms have the same frequency (but the Figure 18 doesn't reveals the fact).

It must be mentioned that as it concerns the FOR sector, 25% of the firms working mainly for export (more accurate: their exports exceed 75% from turnover value) are losing-exporters. This seams to be a surprise. The export-loss can be explained for small levels of exports. But in a firm whose exports exceed 75% from turnover value, the losing-exports can not be compensated and frequently implies a negative yearly balance sheet (confirmation: between the 51 FOR firms whose exports exceed 75% from their turnover and present a negative yearly balance sheet, 32 are losing- exporter).

INV. Table 12 shows the relative aggregate investing effort: the aggregate investments-turnover ratio (Definition 2, §4.1) of FOR is over 100% in 11 out of the 13 subsections where it could be calculated (ratios smaller than 100% refer to EE and EK).

K1. The survey conducted on 1400 firms (Figure 5) shows that the capital utilization level is very different, subject to subsections, as it follows: the median values of the utilization level vary between EB, EC (about 80%) and EG (about 30%). More, the subsection variability is high. (The EG subsection has the maximal variability: 25% from the firms have a capital utilization under 20%, but another percent of 25% from the firms have a capital utilization above 70%.)

K2. The available data (1400 firms) point up that the capital utilization level increases at the same time with the export level (Figure 7). A theoretical confirmation is the estimated correlation coefficient of 0.41 between the share of utilized capital and the share of exports in the turnover value.

K3. The available data (1400 firms) show that the increasing order of the capital utilization level is: FOR, PrivRO and STATE. This conclusion is, generally, found again for each NACE subsection. (The exceptions revealed by the Figure 6 for the subsections EG, EI, EL and EN have a statistical significance.)

MI1. The weight of imported materials (more accurate –raw materials and materials, water and energy not included) is significantly higher as far as the FOR firms are concerned (see Figure 16). Indeed, in all subsections, except for one statistically non-significant case, the median values of the percentage of imported material are higher for FOR firms. In subsections EB and EC – subsections having the highest level of imported materials – the percentage of the imported materials reaches 100% for more than half of the FOR firms.

MI2. The weight of the imported materials is high for the firms that are systematically exporting. This increase is significant for the case of the firms whose export exceeds 50% of their turnover (see Figure 18).

MI3. It can not be ignored the variability of the percentage of imported materials: it is maximal for the firms whose export exceeds 75% of their turnover. Indeed, for a quarter of these firms the percentage of the imported materials is 100% and for another quarter is less than 20% (see Figure 17).

PrK. To analyze the efficiency of the capital K utilization depending on ownership type we shall consider $W(T:K \mid TP)$, the ratio of the aggregate distributions of the turnover T and K (see Definition 2, §4.1). This indicator can be written as ratio between the capital productivity conditioned by the ownership type and the capital productivity as calculated in the whole subsection. $W(T:K \mid TP)$ is represented in Figure 11.

It can be noticed that the capital productivity ratio of STATE firms is less than 100% for all subsections. More, in 10 out of the 13 presented subsections the capital productivity ratio is the highest for FOR. Thus, the foreign property is favorable for high values of the ratio T/K.

PrL1. To study the labor L efficiency depending on the ownership type, similar to the above paragraph PrK, we defined $W(T:L \mid TP)$ which can be re-written as the ratio between the labor productivity conditioned by the ownership type and the labor productivity as calculated in the whole subsection. It can be noticed that the labor productivity ratio is higher for FOR firms in all subsections without any exception.

PrL2. Statistics W(VA:L│TP) has a significance similar to the above mentioned statistics, but for one difference: the labor productivity is calculated depending on the value added, VA. (The ratio W(VA:L | TP) is summarized in Table 9.) In this case also the labor productivity ratio is higher in respect to the FOR firms and only two statistically non-significant exceptions are registered. It could seem unexpected the conclusion that the STATE aggregate labor productivity is exceeding the PrivRO aggregate labor productivity in spite of the fact that in 12 subsections the order is reversed. The situation appears because of the high weight (30%, in the year 1998) of the metallurgy in the turnover of the Romanian manufacturing industry.

PrL3. In FOR sector and also – at a diminishing intensity – in PrivRO sector, the labor productivity is decreasing with the increase of the exports weight in the turnover value. (See Figure 10.)

PROF1. The profitability of a subsection will be estimated separately for each ownership type according to the following indicator, aggregated at subsection level:

$$YPS_i = 100 \times (prof_i - loss_i) / turn_i$$

where:

i= factor level (here, ownership-type of the firm)

$prof_i$ = sum of profits made by all firms in a specified subsection and belonging to type "i" ownership;

$loss_i$ = sum of losses incurred by all firms in a specified subsection and belonging to type "i" ownership;

$turn_i$ = turnover sum achieved by all firms in a specified subsection and belonging to type "i" ownership.

This indicator is represented in Table 13.

It can be noticed that the STATE sector brings in aggregate profit in none of all subsections. (It must be stressed the exact meaning of the statement: as it concerns the STATE sector, for each NACE subsection, the sum of the profits is exceeded by the sum of losses. But for the subsections EJ and EK the aggregate losses are recorded by each of three ownership types!)

PROF2. The Figures 15 presents the profit making firms, only. Three export levels are considered. We must draw the attention, otherwise than in the previously discussed PROF1, there are not any aggregated values in Figure 15. Here median values are considered, separately, by exports level. It seems that – but the conclusion has not been statistically checked – the middle export level (25%-75%) do not favor high profitability in case of profit making firms.

VA. Table 8 presents the ratio of the aggregate distributions of the value added and turnover, conditioned by the ownership type, W(VA:CA│TP). The STATE sector has maximum values of the aggregate ratio in 9 subsections: EA, ED, EE, EF, EH, EJ, EK, EL and EM. The PrivRO sector has maximum values of the aggregate ratio in 7 subsections: EB, EC, EG, EI, EL (the same value with

STATE sector), EN and EO. In 10 from the subsections, the FOR sector registers the lowest aggregate ratios of the value added and the turnover.

At the aggregate level of manufacturing industry, the ratio of the PrivRO sector is maximal and the ratio of the FOR sector is minimal. This does not contradict the above statement **PrL2** regarding the high level of the labor productivity of FOR sector (productivity calculated in relation to VA). A different view is expressed here: the value added weight in the turnover has the lowest aggregate values in FOR case.

5. CONCLUSIONS

The study was intending to describe the FDI impact in manufacturing industry. Our analysis classified the manufacturing companies by the factors on interest (propriety type, exports level) and compared the classes. In this view, on the one hand, we located the analysis on the microeconomic level of firms and, on the other hand, we defined some aggregated indicators.

We subordinated our approaches to the invariance condition towards the relative weights of the classes (In the Romanian case, because of the FDI small volume, a significant macroeconomic impact of these flows cannot be identified). Also, we chose a static approach: only data concerning year 1998 were considered (diminishing in this way the strong non-homogeneity of the period).

This analysis is not an exhaustive one. Only few aspects subject to be related with the above factorial analysis of FDI impact were briefly mentioned. The data-base allows additional studies concerning the exports impact on manufacturing industry and –perhaps, more fruitful– a detailed analysis at the level of the subsections, groups or classes (NACE 2-4 digits codes).

Two lists of specific and general conclusions of our analysis (some of them not at all described in the precedent chapters) follows.

5.1 Specific conclusions

S1. The ownership type binary classification "foreign/domestic" is inappropriate because of the high non-homogeneity of domestic companies. A three classes structure describes better the ownership type in Romanian '98 manufacturing industry. So, the three values of the factor **TP** were defined as predominant state ownership, predominant domestic private ownership and predominant foreign ownership (in abbreviate: **STATE**, **PrivRO** and **FOR**).

S2. At the micro-economic *level of the firms*, the static estimate of TFP, the total factor productivity, is significantly higher in private firms (PrivRO or FOR) comparing with STATE firms. There is a positive but statistically non-significant difference between FOR and PrivRO firms.

S3. At the *firm level*, the capital **K** contribution to the production function is higher in private firms (PrivRO or FOR) comparing with STATE firms. There is not a significant difference between FOR and PrivRO firms. This may mean a higher technological level or a decrease of the sub-utilization of the capital.

S4. At the *firm level*, the labor **L** contribution to the production function is maximal in PrivRO firms. There is not a significant difference between FOR and STATE firms.

S5. At the *firm level*, the decreasing order of materials **M** contribution to the production function (expressed by the value of expenses on raw materials, materials, energy and water) is STATE, PrivRO and FOR. This must be connected to our conclusions on the imported materials (energy and water excluded). Indeed, the weight of the imported materials is significantly higher in FOR firms and systematically exporting firms.

S6. At the *firm level*, the decreasing order of subcontracting **S** contribution to the production function is FOR, PrivRO and STATE.

S7. The production function behaves quite similar under the influence of the factors **TP** and **EXP.** Here, **EXP** is a factor describing the exports. The 3 levels of the EXP are low, intermediate and high. They were defined depending on the export share in the turnover value (the rate **Vexp/Turnover**) as: Vexp/Turnover in [0% 25%), or in [25% 75%), or in [75% 100%], respectively.

All statements regarding the impact of the factors' levels 1 and 3 (low and high for EXP and respectively, STATE and FOR for TP) on the coefficients λ, α, γ, δ of the Cobb-Douglas production function (1) §2.2

$$Y= A\, K^{\alpha}\, L^{\beta}\, M^{\gamma}\, S^{\delta}$$

are identical. (The coefficients λ, α, γ, δ describe the static TFP index and, respectively, the K, M and S variables contribution to the production function.) There are at least two reasons for such similarity:

- The distribution of firms by the factors' levels. More precisely, the FOR ownership is associated with a high export volume while the STATE ownership is associated with a low export volume.
- A latent factor acting upon the production function. This factor is the contact with the international economic environment briefly called *" contact with the outside world"* (obviously, the contact with outside is active both in exports and in FDI).

There is no such similarity of the factors in regard with labor L (exports and ownership-type affect the L variable in a less direct way, by agency of the corporate management, expansion policies, etc.). The lack of the similarity in case of L reveals that the two factors, even dependent to "the contact with the outside world", did not reduce to the latent factor.

S8. At the *firm level*, the labor productivity seems to decrease when the export share increases. This tendency is evident especially in FOR sector (the sector of the higher productivity), but also –at a lower scale– in PrivRO sector. In STATE sector the exports level did not significantly modify the labor productivity (see Figure 10).

S9. Prevalent ownership-type and exports level are dependent factors.

S9.1 At the *firm level*, the frequency and intensity of the export activities are maximal in FOR sector (see Table 1).

S9.2 At the *aggregate level* of the manufacturing industry, the exports share in turnover is maximal in STATE sector. There is no a significant difference between the FOR and PrivRO sectors. In spite of these, we disagree with the standpoint, rather widely spread, that domestic market is the main motivation of FDI in Romania.

Actually, Romania's case can be described as follows (see Table 14):

- on the one hand, the FOR sector mainly produce for export in EB (the textile industry), ED (the wood working industry) and in EO (the other industrial activities) –where the aggregate export production value is over 70% of the aggregate turnover at the subsection level– and in EJ (the metallurgical industry), EK (metal structures and metal products), EL (machine and equipment building) and EN (the transport vehicles industries) –with the exports values between 54% and 69%;
- on the other hand, the FOR sector produces almost exclusively for the domestic market in EA (the food, beverage and tobacco industry), EH (the rubber and plastics manufacturing), EM (in the electrical and optical equipment industry) and EE (the cellulose and paper industry), where the production for the domestic market reaches 99%, 90% , 86% and 79%, respectively.

S9.3 The statements **S9.1** and **S9.2** seem to be contradictory, but they are not. The explanation can be found by taking into account the Romanian '98 manufacturing industry structure: the small number of STATE firms (25% from the manufacturing firms, only); the high weight of STATE sector turnover (60% of the aggregate value of the manufacturing industry turnover); the aggregate distribution of the exports' value (52%, 35% and 13% for STATE, PrivRO and FOR, respectively).

S9.4 The two-way factorial analysis (actually performed by us, but not described in this particular paper) has identified no any significant interaction between the ownership type and exports level. We may draw the conclusion that no synergy effect exists between export level and ownership type in the production function.

5.2 General conclusions

G1. Our analysis pointed out that, comparing to domestic sector (STATE or PrivRO), the FOR sector is significantly more efficient. *At firm level* it has maximal TFP, higher labor productivity, higher capital productivity, better capital utilization, superior management (at list as it concerns the subcontracting benefits), higher exports intensity, bigger profitability and superior investment effort.

G2. The above conclusion must be qualified by taking into account that, on the one hand, *at aggregate level,* the weight of value-added in the turnover is minimal in FOR sector. (This finding confirms the wide spread opinion among specialists that FDI are predominantly channeled in low value added activities–see also Table 8.) On the other hand, *at firm level,* the weight of the imported materials is high in FOR sector and, also, for systematically exporting firms.

G3. There is a striking discrepancy between the FOR sector's superlatives (mentioned in **G1**) and the findings pointed out by Table 19. Indeed, in '98 the frequency of loss-making firms was around 31% in FOR sector, comparing to 26% in PrivRO sector. (The frequency of loss-making firms in STATE sector was more than 50%.) Moreover, as it concerns the FOR sector, 25% of the firms working mainly for export (i.e. the exports exceed 75% from turnover) are losing-exporters. Generally, for the exporting firms, the percentage of losing-exporters are 20% for STATE and FOR sectors but only 10% for PrivRO sector (see the statement **EXP4** in §4.2).

As it concerns FOR sector, the explanations of the negative yearly balance sheet and losing-exports would be: the transfer prices practices, the dumping practices, the development policies, a unfavorable conjuncture or a misevaluation of market tendencies, and "book-keeping engineering" with fiscal purposes.

G4. The **G3** remarks are pointing out *the bipolar structure of the FOR sector: the best performance firms and the structural low-performance firms*.

(A proof by reducing ad absurdum of the existence of the bipolar structure of FOR sector is following. Considering the FOR sector's superlatives (mentioned in **G1**), the homogeneity hypothesis of FOR sector necessarily implies a smaller frequency of negative balance sheet and also a smaller frequency of loses-exporter of FOR sector comparing with PrivRO sector. But the empirical evidences from G3 contradict the statement. So, the homogeneity hypothesis can not be true. The FOR sector comprises –at least– two sub-sectors: the best performance firms and the low-performance firms. The best performance firms are sufficiently efficient and numerous to impose the superlatives listed in **G1** as a tendency of the FOR sector, while the low-performance firms are enough numerous to significantly increase the frequency of the loss-making firms.)

G5. Finally, the low level of FDI, the FOR bipolar structure, the small value-added and the high amount of imported materials in FOR sector explain altogether why foreign investment has a slight macro-economic impact on the restructuring process in the Romanian economy. The statement refers to the year 1998, but it is also consistent with the developments in the years 1999 and 2000. Moreover, if new developments will not occur in the future, so as to modify the trends identified in our paper, it is reasonable to consider that the future foreign investments in Romania, even being substantial, will have a lower macro-economic effect than the normally expected one.

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APPENDIX

A1. Sample description

Table 1. The sample of manufacturing firms on ownership-type and export level (manufacturing firms having at least 50 employees*)

		Prevailing Ownership			Total
		STATE	PrivRO	FOR	
EXP8_4	EXP<1%	360 50.0%	905 52.3%	106 30.0%	1371 48.9%
	[1% 25%)	171 23.8%	261 15.1%	38 10.8%	470 16.8%
	[25% 75%)	159 22.1%	254 14.7%	44 12.5%	457 16.3%
	EXP>= 75%	30 4.2%	310 17.9%	165 46.7%	505 18.0%
Total		720 100.0%	1730 100.0%	353 100.0%	2803 100.0%

* 1998 data. The sample is input of the factorial and aggregate analysis. The percentages can be used as unbiased estimates for the Romanian 1998 manufacturing industry.

Table 2. The sample of manufacturing firms on NACE and ownership-type*

NACE Subsection		Predominant ownership			Total
		STATE	PrivRO	FOR	
EA	Food, beverage and tobacco industry	145 25.3%	359 62.8%	68 11.9%	572 100.0%
EB	Textile industry and of textile fabrics	86 15.2%	365 64.7%	113 20.0%	564 100.0%
EC	Leather and footwear industry	8 5.8%	87 62.6%	44 31.7%	139 100.0%
ED	Wood working industry (except furniture)	14 10.1%	104 75.4%	20 14.5%	138 100.0%
EE	Cellulose, paper, cardboard, paper And cardboard products industry	17 15.3%	82 73.9%	12 10.8%	111 100.0%
EF	Industry of oil processing, coal coking And nuclear fuels processing	5 55.6%	4 44.4%		9 100.0%
EG	Chemical and synthetical and artificial fibers industry	36 35.6%	47 46.5%	18 17.8%	101 100.0%
EH	Rubber and plastics manufacturing industry	11 17.2%	45 70.3%	8 12.5%	64 100.0%
EI	Industry of other products made of non-metallic minerals	46 27.1%	115 67.6%	9 5.3%	170 100.0%
EJ	Metallurgical industry	46 62.2%	26 35.1%	2 2.7%	74 100.0%
EK	Metal structures, metal products industry (except machines, equipment, installations)	55 27.8%	133 67.2%	10 5.1%	198 100.0%
EL	Machine and equipment building industry	127 56.4%	90 40.0%	8 3.6%	225 100.0%
EM	Electrical and optical equipment industry	31 32.0%	48 49.5%	18 18.6%	97 100.0%
EN	Industry of transport vehicles	51 47.2%	50 46.3%	7 6.5%	108 100.0%
EO	Other industrial activities	42 18.0%	175 75.1%	16 6.9%	233 100.0%
	TOTAL	720 25.7%	1730 61.7%	353 12.6%	2803 100.0%

* This sample is input of the factorial and descriptive analysis. The sample percentages from the table can be used as unbiased estimates for the Romanian manufacturing industry, except the section EF.

A2. Descriptive Statistics
(manufacturing industry, 1998 data)

Table 3. Fixed Assets Distribution* by Ownership (1998 Data)

NACE Subsections	K STATE	K PrivRO	K FOR
EA	38.2	44.1	17.7
EB	36.8	46.2	17.0
EC	25.7	60.5	13.8
ED	27.5	64.5	7.9
EE	59.3	34.4	6.4
EF	88.0	12.0	0.0
EG	63.3	19.0	17.6
EH	9.3	87.9	2.8
EI	34.5	45.5	19.9
EJ	93.0	7.0	0.0
EK	44.1	51.1	4.8
EL	83.7	13.9	2.4
EM	38.1	34.8	27.0
EN	83.3	8.4	8.3
EO	35.7	60.5	3.8
E (Total)	61.4	29.2	9.5

* percentages of Subsection Total

Table 4. Turnover Distribution* by Ownership (1998 Data)

NACE Subsections	T STATE	T PrivRO	T FOR
EA	21.3	52.3	26.4
EB	15.1	62.8	22.1
EC	13.8	57.6	28.6
ED	9.8	76.7	13.5
EE	38.8	48.6	12.5
EF	72.1	27.9	0.0
EG	52.5	21.6	26.0
EH	8.3	87.7	4.1
EI	25.0	63.2	11.7
EJ	92.1	7.8	0.1
EK	30.0	59.0	11.0
EL	68.8	26.7	4.5
EM	23.3	41.9	34.8
EN	79.3	15.1	5.6
EO	18.6	74.6	6.8
E (Total)	47.2	38.6	14.1

* percentages of Subsection Total

Figure 5

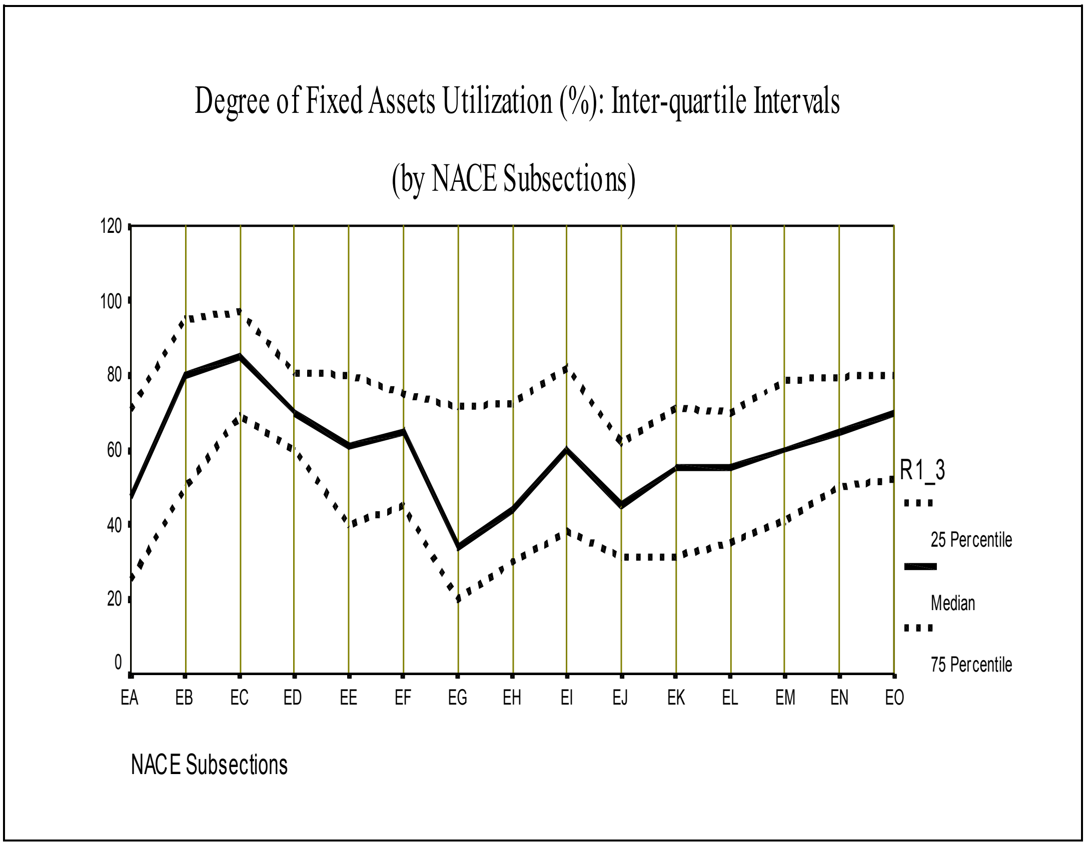


Figure 6

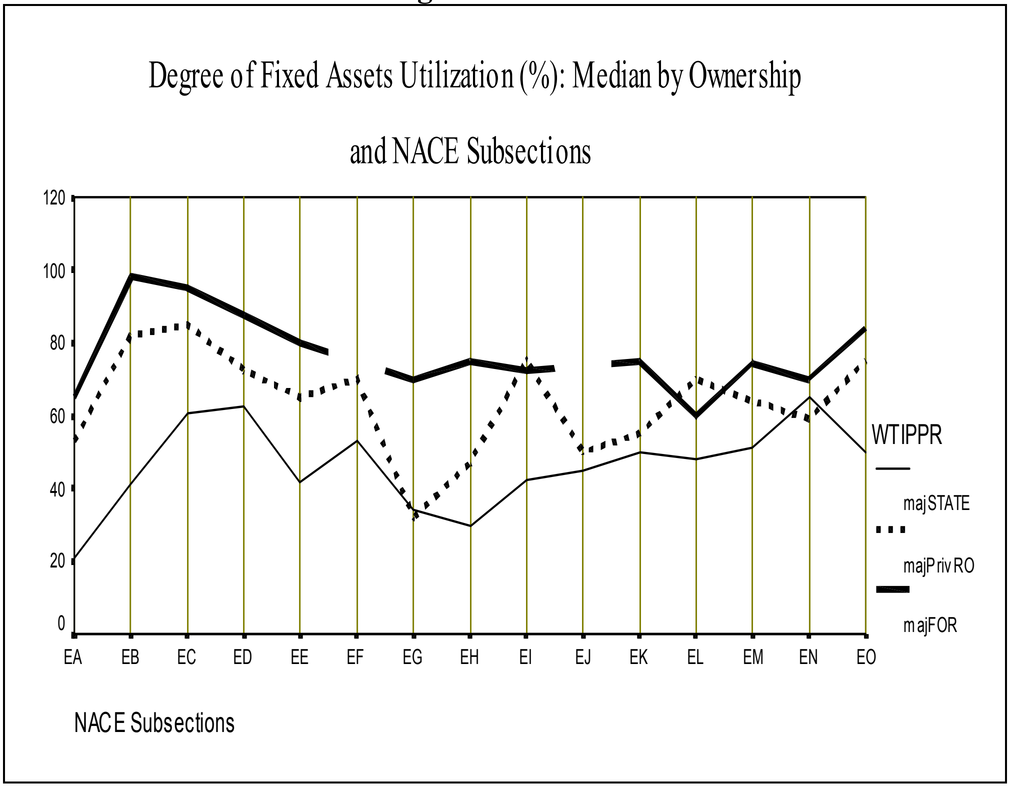


Figure 7

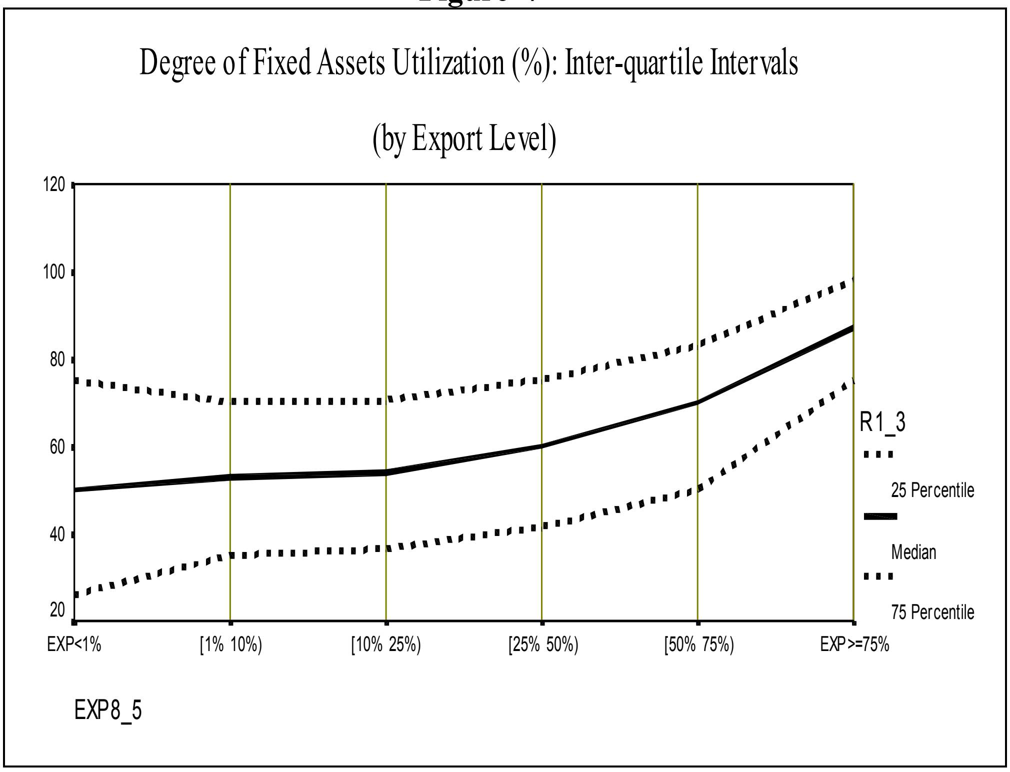


Table 8. Value Added -Turnover Ratio* By Ownership (%) (1998 Data)

NACE Subsections	va/t STATE	va/t PrivRO	va/t FOR
EA	142	92	83
EB	91	108	84
EC	106	115	67
ED	120	104	60
EE	102	100	94
EF	115	60	
EG	77	131	121
EH	103	101	63
EI	90	104	101
EJ	102	78	
EK	108	104	57
EL	101	101	84
EM	147	113	53
EN	96	115	109
EO	101	103	64
E (Total)	93	112	91

*** VA/T Ratio = (Ownership-type Value Added / Total Value Added) /(Ownership-type Turnover / Total Turnover) * 100; See Def2 §4.1**

Table 9. Labor Productivity I Ratio * by Ownership (%) (1998 Data)

NACE Subsections	va/lab STATE	va/lab PrivRO	va/lab FOR
EA	105	80	192
EB	76	102	121
EC	86	96	136
ED	68	105	123
EE	90	97	193
EF	122	53	
EG	64	119	237
EH	74	103	101
EI	82	105	119
EJ	103	67	
EK	81	111	136
EL	92	118	204
EM	79	101	183
EN	97	102	151
EO	72	109	119
E (Total)	96	93	164

*** Labor Productivity Ratio = Ownership-type Labor Productivity / Subsection Productivity (where Labor Productivity I = Value Added / / Number of Employees); See Def2 §4.1**

Figure 10

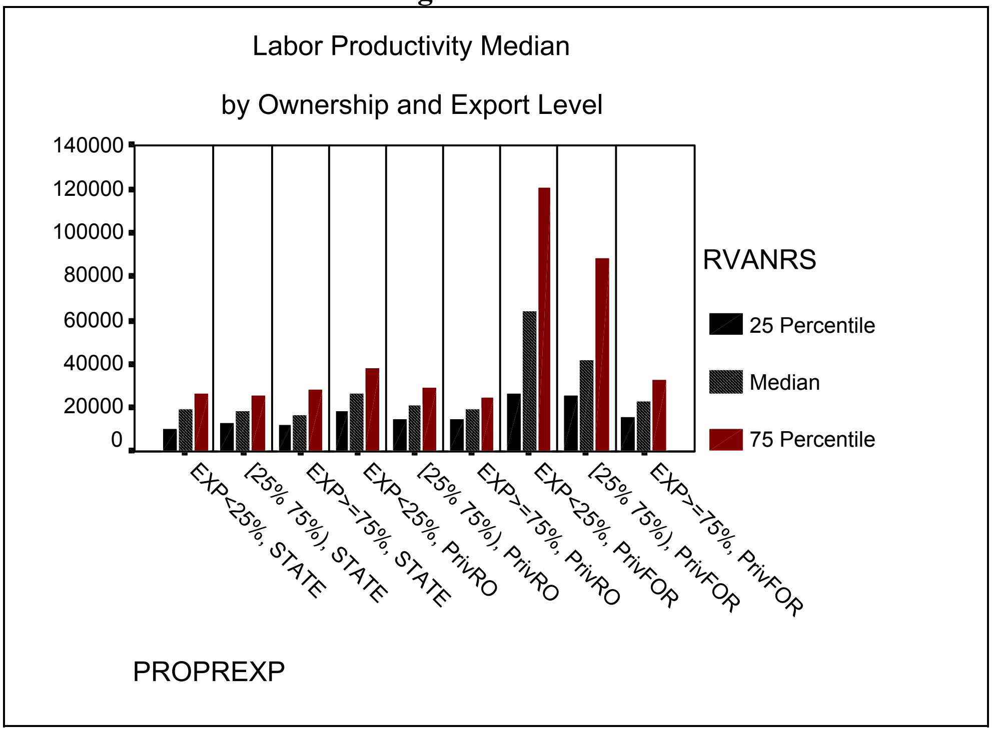
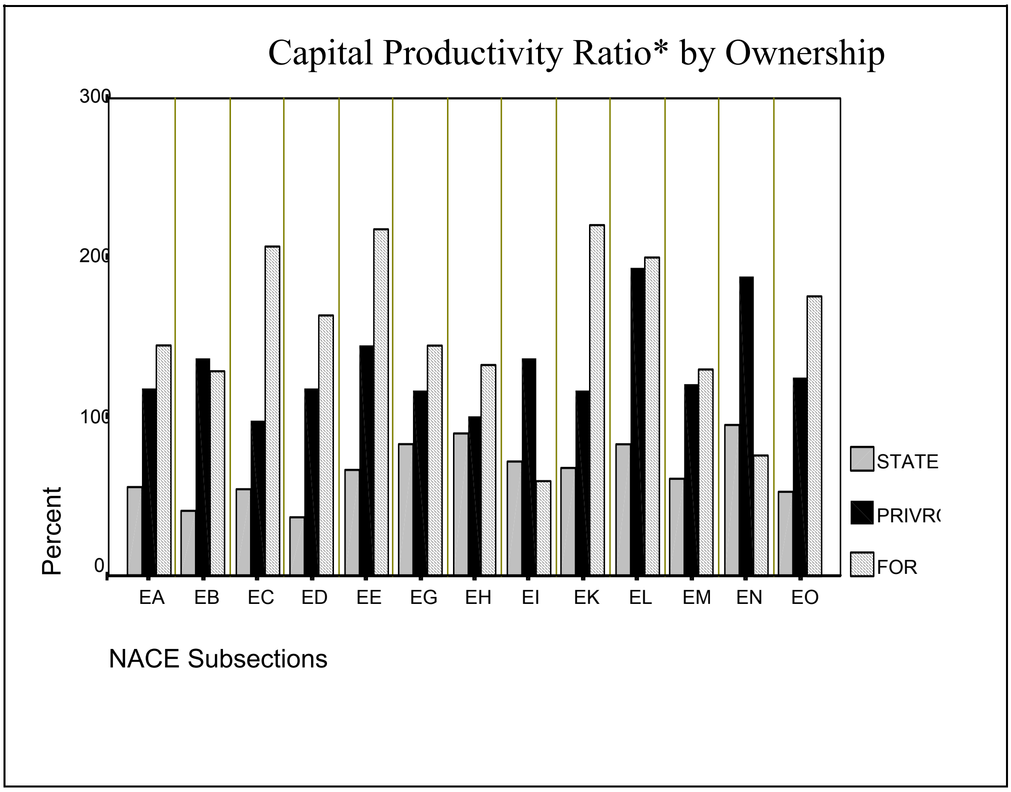


Figure 11



* Capital Productivity Ratio = (Subsection Ownership-type Capital Productivity) / (Subsection Capital Productivity) * 100 (where Capital Productivity = Turnover / Fixed Assets), Def2 §4.1.

Table 12. Investment - Turnover Ratio by Ownership* (%) (1998 Data)

NACE Subsections	i/t STATE	i/t PRIVRO	i/t FOR
EA	88	92	124
EB	103	98	102
EC	67	77	162
ED	14	89	223
EE	87	111	96
EF	101	97	
EG	61	85	191
EH	13	102	241
EI	17	93	315
EJ	103	60	
EK	18	156	24
EL	77	152	145
EM	109	72	128
EN	74	110	435
EO	23	117	127
E (Total)	74	108	163

* See Def2 §4.1 I / T Ratio =
=(Ownership-type Investment / Total Investment)
/ (Ownership-type Turnover / Total Turnover) ;

Table 13. Profitability by Ownership* (%)

NACE Subsection	Pr/t STATE	pr/t PRIVRO	pr/t FOR
EA	-4.7	2.7	3.8
EB	-19.5	6.9	12.6
EC	-12.1	1.8	11.7
ED	-11.5	0.7	2.7
EE	-1.1	3.1	5.2
EF	-22.8	3.4	
EG	-6.9	9.8	3.0
EH	-8.0	1.1	8.6
EI	-5.8	11.4	1.2
EJ	-5.8	-11.0	
EK	-9.3	-0.2	-17.8
EL	-5.5	1.9	6.8
EM	-0.5	7.5	9.7
EN	-5.9	9.9	-8.9
EO	-8.3	3.4	0.5
E (Total)	-7.5	4.2	4.8

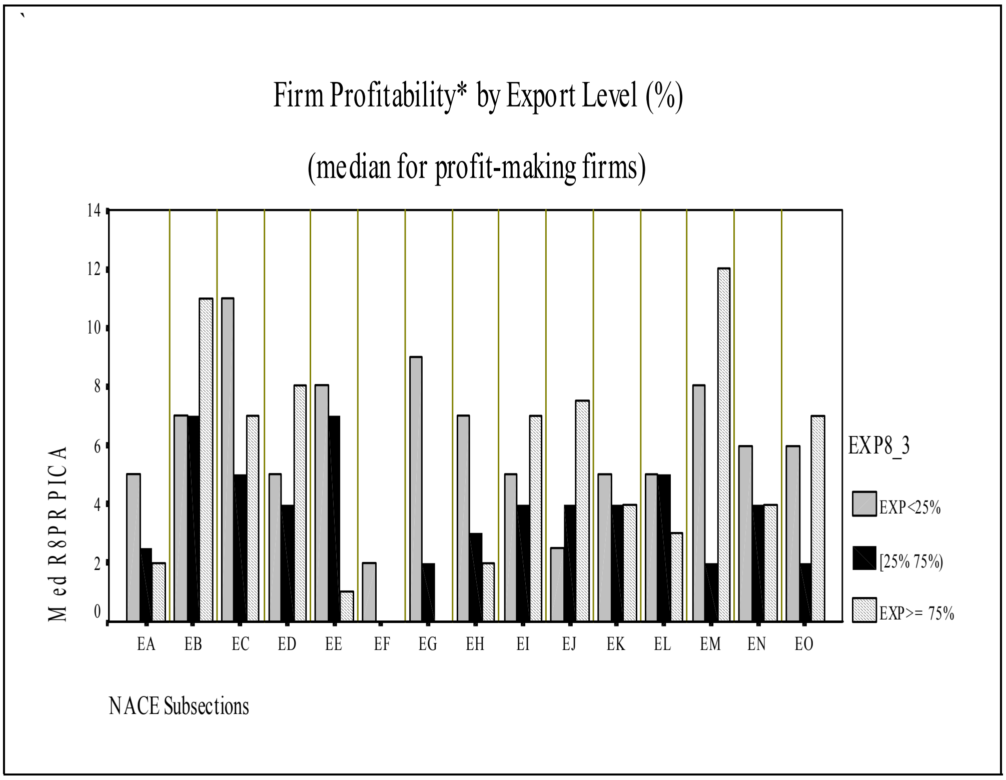
* (1998 data) NACE Subsection Profitability (%) = =(Profits – Losses) / (Turnover) * 100 : all quantities are aggregate values for a specified ownership-type.

Table 14. Share of Export in Turnover by Ownership* (%)

NACE Subsections	e/t STATE	e/t PrivRO	e/t FOR
EA	2	5	1
EB	36	57	74
EC	45	54	37
ED	24	41	71
EE	15	7	21
EF	39	4	
EG	37	13	28
EH	23	19	10
EI	14	27	26
EJ	40	31	
EK	19	21	63
EL	32	23	55
EM	17	22	14
EN	16	10	54
EO	48	55	72
E (Total)	29	24	25

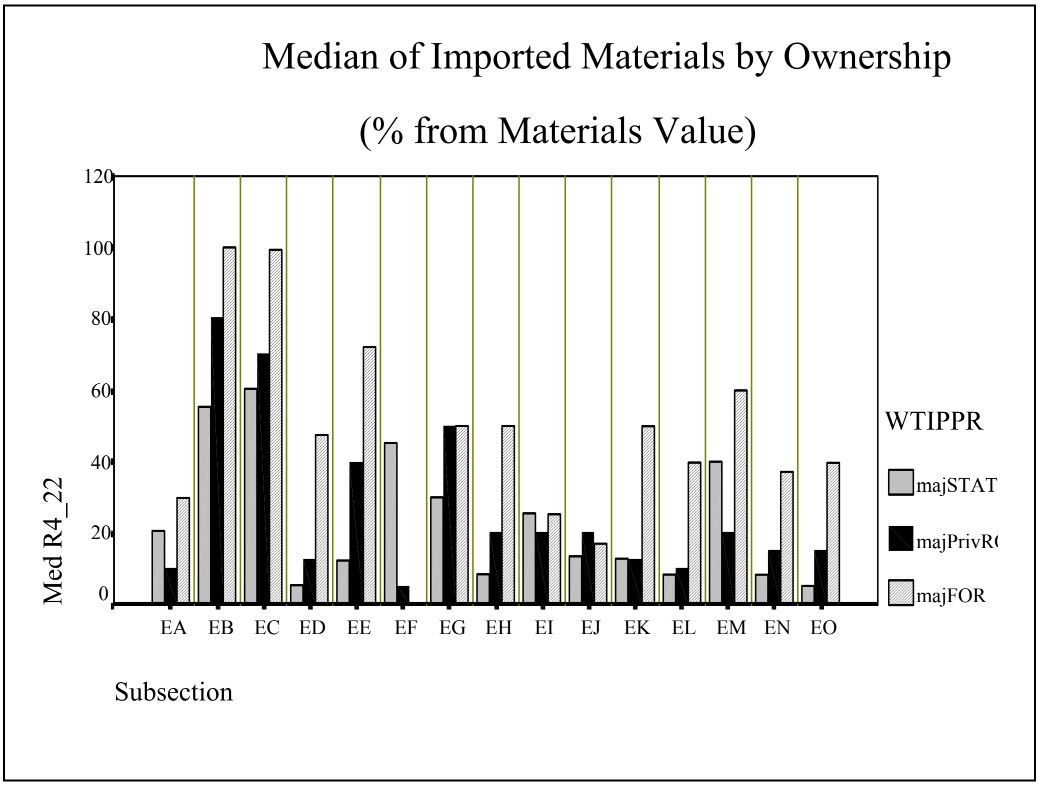
* (1998 Data) percentages from Subsection Turnover

Figure 15



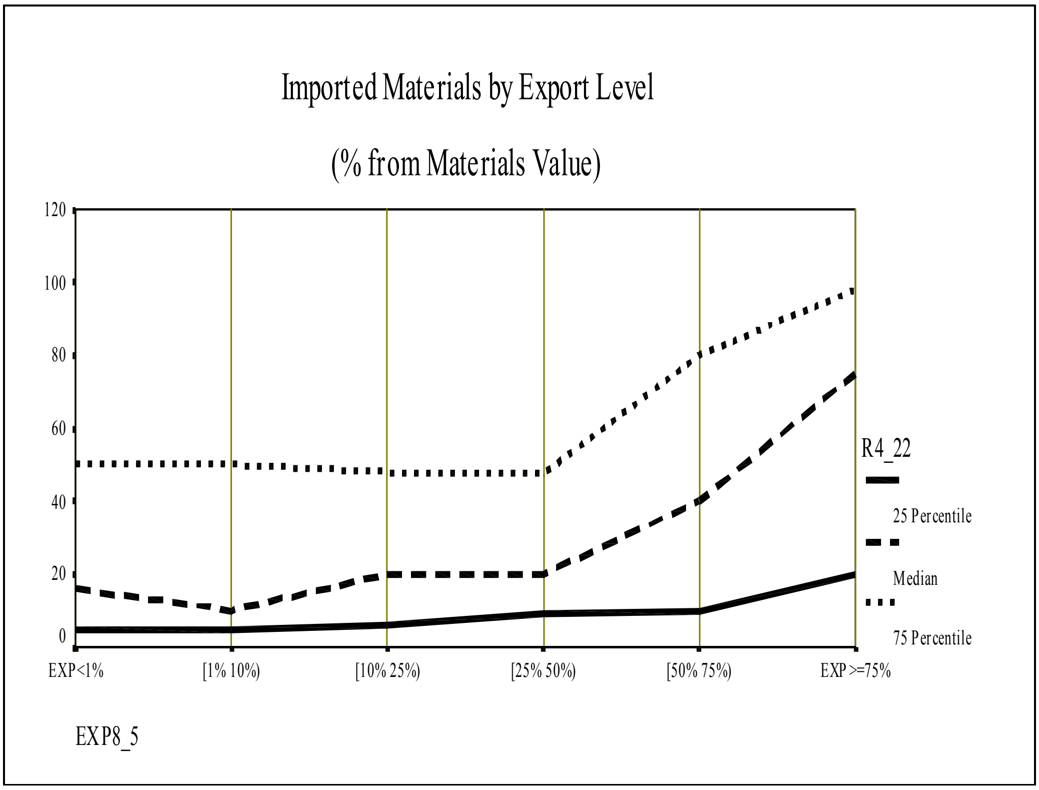
* Profitability = profit / turnover*100

Figure 16*



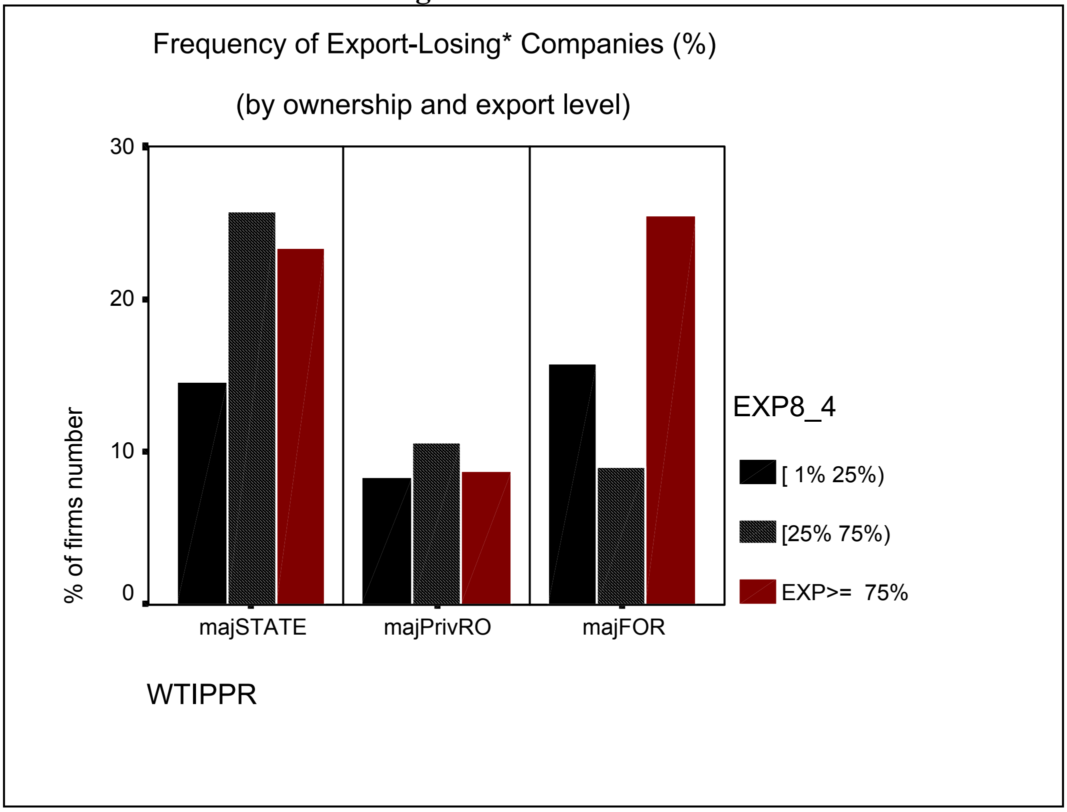
* Raw materials and materials, water and energy not included.

Figure 17



* Raw materials and materials, water and energy not included.

Figure 18



* Export Expenditure > Export Earnings (only exporting firms were considered).

Table 19. Manufacturing Firms Distribution
(by Ownership, Export Level and Profit/Loss)

Export, Ownership		Loss	Profit	Total
EXP< 1%,	**STATE**	212 (58.9%)	148 (41.1%)	360 (100.0%)
[1% 25%),	**STATE**	87 (50.9%)	84 (49.1%)	171 (100.0%)
[25% 75%),	**STATE**	86 (54.1%)	73 (45.9%)	159 (100.0%)
EXP>=75%,	**STATE**	13 (43.3%)	17 (56.7%)	30 (100.0%)
EXP< 1%,	**PrivRO**	270 (29.8%)	635 (70.2%)	905 (100.0%)
[1% 25%),	**PrivRO**	56 (21.5%)	205 (78.5%)	261 (100.0%)
[25% 75%),	**PrivRO**	72 (28.3%)	182 (71.7%)	254 (100.0%)
EXP>=75%,	**PrivRO**	48 (15.5%)	262 (84.5%)	310 (100.0%)
EXP< 1%,	**FOR**	33 (31.1%)	73 (68.9%)	106 (100.0%)
[1% 25%),	**FOR**	11 (28.9%)	27 (71.1%)	38 (100.0%)
[25% 75%),	**FOR**	14 (31.8%)	30 (68.2%)	44 (100.0%)
EXP>=75%,	**FOR**	51 (30.9%)	114 (69.1%)	165 (100.0%)
TOTAL:	Count (%)	953 (34.0%)	1850 (66.0%)	2803 (100.0%)

A3. Statistical analysis models
(manufacturing industry, 1998 data)

Model M1.
Log-linear regression of production

Regression Coefficients for Dependent Variable LPREX8M, Production value

Model	Unstandardized Coefficients		Standardized Coefficients			95% Confidence Interval for B	
	B	Std. Error	Beta	T	Sig.	Lower Bound	Upper Bound
LKAP8M	-1.854E-02	.005	-.023	-3.788	.000	-.028	-.009
LLAB8M	.298	.009	.245	33.579	.000	.281	.316
LMAT8M	.475	.006	.543	74.951	.000	.463	.488
LSUBC8M	.300	.006	.295	48.110	.000	.288	.312

M1. Univariate Analysis of Variance: Tests of Between-Subjects Effects

Dependent Variable: LPREX8M

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	4201.793	4	1050.448	15579.535	.000
LKAP8M	.967	1	.967	14.348	.000
LLAB8M	76.024	1	76.024	1127.538	.000
LMAT8M	378.766	1	378.766	5617.602	.000
LSUBC8M	156.058	1	156.058	2314.550	.000
Error	188.790	2800	6.742E-02		
Total	4390.583	2804			

R Squared = .957 (Adjusted R Squared = .957)

Model M2.
Factorial analysis of production conditioned by the factor EXP (3 levels)

Estimated parameter values (see relation (9))

Factor: **EXP**	**Main effect**	τ_1 **EXP<25%**	τ_2 **EXP 25 % -75%**	τ_3 **EXP>75%**	**Significant relationships due to EXP factor (for significance level 0.05)**
λ	0.020 (.079)	-0.029 (.024)	-0.066 (.001)	0 ( )	$\lambda_3>\lambda_1$, $\lambda_3>\lambda_2$
Capital K α	0.040 (.001)	-0.067 (.001)	-0.042 (.009)	0 ( )	$\alpha_3>\alpha_1$, $\alpha_3>\alpha_2$
Labor L β	0.421 (.001)	-0.169 (.001)	-0.119 (.001)	0 ( )	$\beta_3>\beta_1$, $\beta_3>\beta_2$
Materials M γ	.285 (.001)	0.293 (.001)	0.152 (.001)	0 ( )	$\gamma_1>\gamma_2>\gamma_3$
Subcontracting S δ	.310 (.001)	-0.053 (.001)	0.002 (.931)	0 ( )	$\delta_3>\delta_1$

NOTE: The reference value is 0. The corresponding significance level is marked with ( ).
Marking (.001) has the following meaning: "significance level is lower than 0.001".

M2. Univariate Analysis of Variance: Tests of Between-Subjects Effects

Dependent Variable: LPREX8M

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	4232.842[a]	14	302.346	5345.731	.000
Intercept	.205	1	.205	3.617	.057
EXP8_3	.846	2	.423	7.475	.001
LKAP8M	2.764E-02	1	2.764E-02	.489	.485
LLAB8M	62.525	1	62.525	1105.500	.000
LMAT8M	194.137	1	194.137	3432.508	.000
LSUBC8M	99.846	1	99.846	1765.362	.000
EXP8_3 * LKAP8M	2.139	2	1.069	18.906	.000
EXP8_3 * LLAB8M	3.928	2	1.964	34.728	.000
EXP8_3 * LMAT8M	25.460	2	12.730	225.081	.000
EXP8_3 * LSUBC8M	1.103	2	.551	9.747	.000
Error	157.741	2789	5.656E-02		
Total	4390.583	2804			
Corrected Total	4390.583	2803			

a. R Squared = .964 (Adjusted R Squared = .964)

<u>Model M3</u>.
Factorial analysis of production conditioned by the factor TP of prevailing ownership-type

M3.Estimated values of the parameters (see relation (9))

Factor: **TP**	**Main effect**	π_1	π_2	π_3	**Significant relationship due to TP factor (for significance level 0.05)**
λ	0.054 (.002)	-0.093 (.001)	-0.043 (.022)	0 ( )	$\lambda_3>\lambda_1$, $\lambda_3>\lambda_2$
Capital K α	0.036 (.003)	-0.069 (.001)	-0.048 (.001)	0 ( )	$\alpha_3>\alpha_1$, $\alpha_3>\alpha_2$
Labor L β	0.259 (.001)	-0.049 (.118)	0.072 (.004)	0 ( )	$\beta_2>\beta_3$, $\beta_2>\beta_1$
Materials M γ	0.396 (.001)	0.241 (.001)	0.065 (.001)	0 ( )	$\gamma_1>\gamma_2>\gamma_3$
Subcontrac-ting S δ	0.333 (.001)	-0.118 (.001)	-0.054 (.002)	0 ( )	$\delta_3>\delta_1$, $\delta_3>\delta_2$

NOTE: The reference value is 0. The corresponding significance level is marked with ( ).
Marking (.001) has the following meaning: "significance level is lower than 0.001".

M3. Univariate Analysis of Variance: Tests of Between-Subjects Effects

Dependent Variable: LPREX8M

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4211.218	14	300.801	4811.841	.000
Intercept	7.658E-02	1	7.658E-02	1.225	.268
WTIPPR	1.408	2	.704	11.258	.000
LKAP8M	1.308E-02	1	1.308E-02	.209	.647
LLAB8M	35.765	1	35.765	572.126	.000
LMAT8M	272.179	1	272.179	4353.972	.000
LSUBC8M	78.355	1	78.355	1253.421	.000
WTIPPR * LKAP8M	1.121	2	.561	8.969	.000
WTIPPR * LLAB8M	1.747	2	.874	13.975	.000
WTIPPR * LMAT8M	8.313	2	4.156	66.487	.000
WTIPPR * LSUBC8M	1.835	2	.918	14.678	.000
Error	174.285	2788	6.251E-02		
Total	4385.505	2803			
Corrected Total	4385.503	2802			

a. R Squared = .960 (Adjusted R Squared = .960)